Hindcast of Currents in the Santa Barbara Channel through SST Assimilation and Buoy Wind Forcing

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LONG-TERM GOALS

To develop a high-resolution, verifiable nowcast and forecast model for the Santa Barbara Channel (SBC) by combining basic understanding of the circulation processes through theory and observations, numerical techniques and data assimilation.

OBJECTIVES

To test an OI (optimal interpolation) scheme that assimilates satellite SST in a previously-developed SBC ocean model forced by NDBC buoy winds.

APPROACH

Oey's (1996,1999) model for the Southern California Bight (SCB) and SBC (Figure 1; see also Oey et al. 1999) was extended to hindcast currents using not only the hourly NDBC buoy winds, but also the Multi-Channel Sea Surface Temperature (MCSST) data derived from the 5-channel Advanced Very High Resolution Radiometers (AVHRR) on board the NOAA-7, -9, -11 and –14 polar orbiting satellites. The period of hindcast was Jan/1997 through Apr/1999. Windstresses were calculated by combining hourly NDBC wind in the vicinity of the channel with historical, monthly COADS wind over the outer region away from the channel. Simulation was first performed with the wind forcing only, and with SST (and SSS) relaxed to monthly climatological values. The surface-to-subsurface temperature correlation statistics were calculated and used in the subsequent simulation that used the MCSST data as surface and, via the correlation statistics, subsurface assimilated fields.

WORK COMPLETED

Model development with OI data-assimilation was completed. A preliminary model/observation comparison was conducted.

RESULTS

The hindcast SST's were compared with those measured at the NDBC sites, and vertical profiles compared with those measured during CalCofi cruises. Model's drifter trajectories were computed and compared with those observed during the SBC field studies. Comparison plots are given in

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Hindcast of Currents in the Santa Barbara Channel through SST Assimilation and Buoy Wind Forcing</td><td colspan="2">5a. CONTRACT NUMBER</td></tr>
<tr><td colspan="2">5b. GRANT NUMBER</td></tr>
<tr><td colspan="2">5c. PROGRAM ELEMENT NUMBER</td></tr>
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<tr><td colspan="8">12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited</td></tr>
<tr><td colspan="8">13. SUPPLEMENTARY NOTES</td></tr>
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http://www.aos.princeton.edu/WWWPUBLIC/lyo/west_coast/. Figure 2 gives two examples from the trajectory comparison.

In summary, the model was able to reproduce the late 1997 El Nino event (poleward advection of warm water) off the California coast (Fig.2a), and the subsequent spring-time cooling and equator-ward flow in Apr/98 (Fig.2b). These and the seasonal cycles of surface currents showed up well in the modeled drifter trajectories, which compared favorably with those observed. The modeled SST compared well with NDBC measurements over the 2 years period. For coastal regions, including the SBC, modeled temperature profiles compared surprisingly well with CalCofi data.

IMPACT/APPLICATIONS

The relative success (despite the simple assimilation scheme and wind forcing used) of the simulation emphasizes the importance of combining theoretical understanding, observations, and numerical modeling. As it is, the model can be used as a nowcast tool in the SBC. We now plan to also include forecast wind products from COAMPS, as well as more rigorous comparison with observations.

TRANSITIONS

Results in the form of IEEE binary files have been submitted to the Navy.

RELATED PROJECTS

The research is in part supported by a grant from The Mineral Management Service (Contract # DOI-10094286; Program Manager: David Brown) via Scripps Institute of Oceanography, so that I work closely with Clinton Winant (SIO) on observational data aspect, and also with Dong-Ping Wang (SUNY), on modeling and data-assimilation aspects.

REFRENCES & PUBLICATIONS

Oey, L.-Y., 1996: Flow around a coastal bend: a model of the Santa Barbara Channel eddy. J. Geophys. Res., 101, 16,667-16,682.

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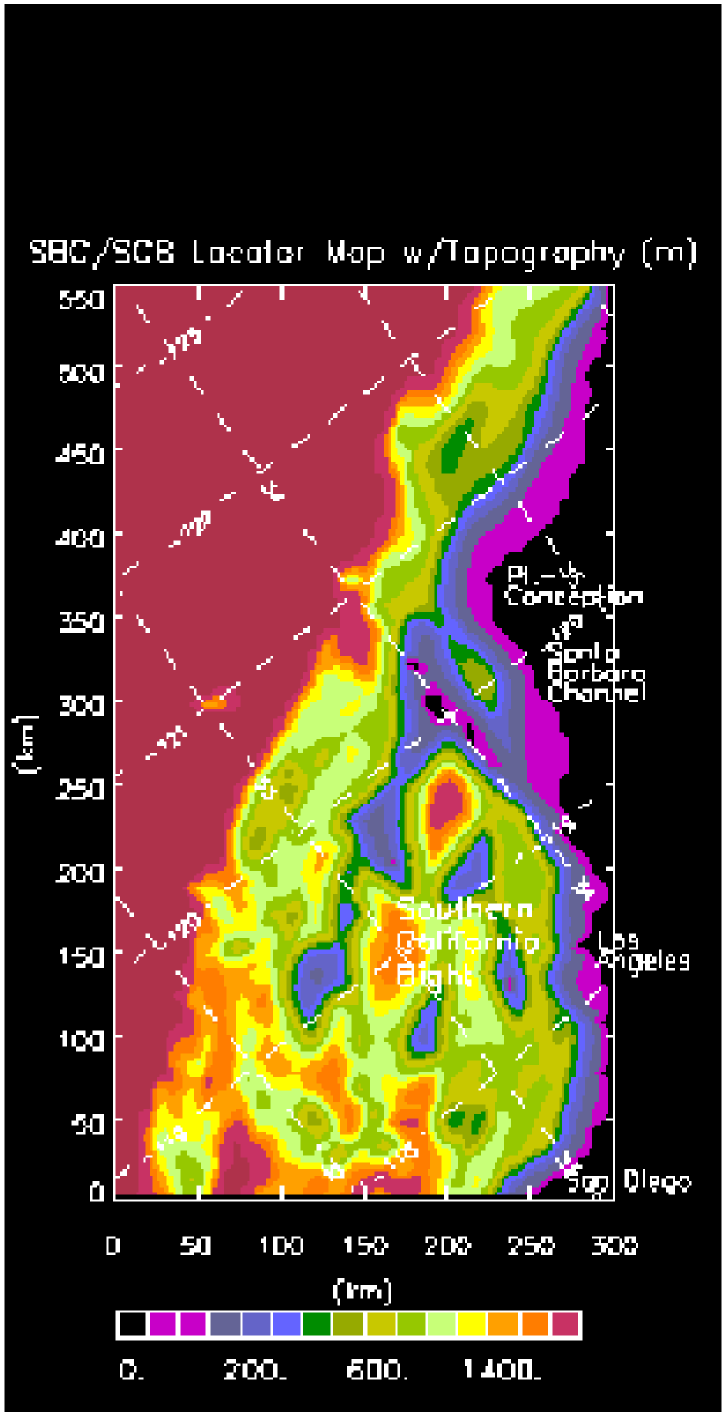
Oey, L.-Y., D.P. Wang, C. Winant, M. Hendershott and T. Hayward, 1999: Momentum Balance from a Hindcast and Nowcast Model of Currents in the Santa Barbara Channel. In Proc. of the 5th Cal. Is. Symposium, May, 1998, in press.



1 Santa Barbara Channel and Southern California Bight locator map and model domain with topography in meters. For computational efficiency, maximum model depth is set to 2000 m.

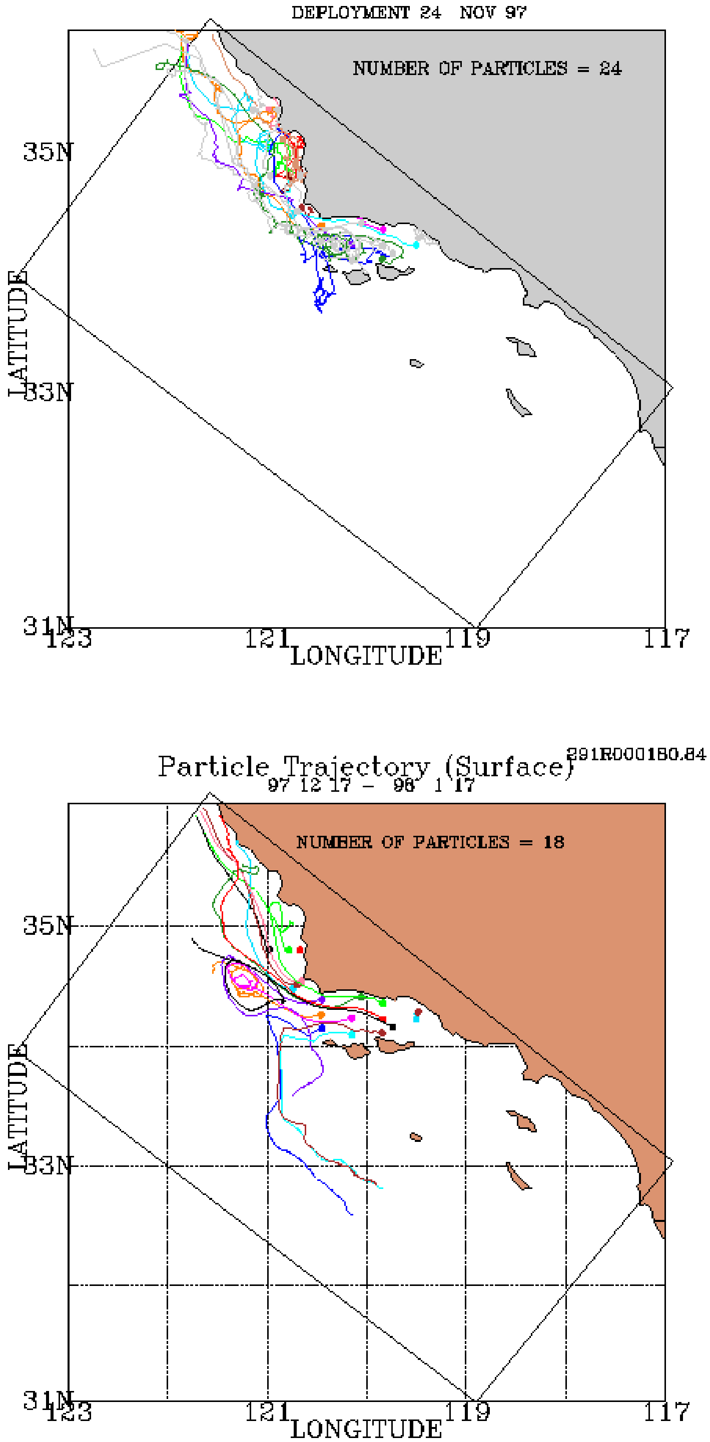

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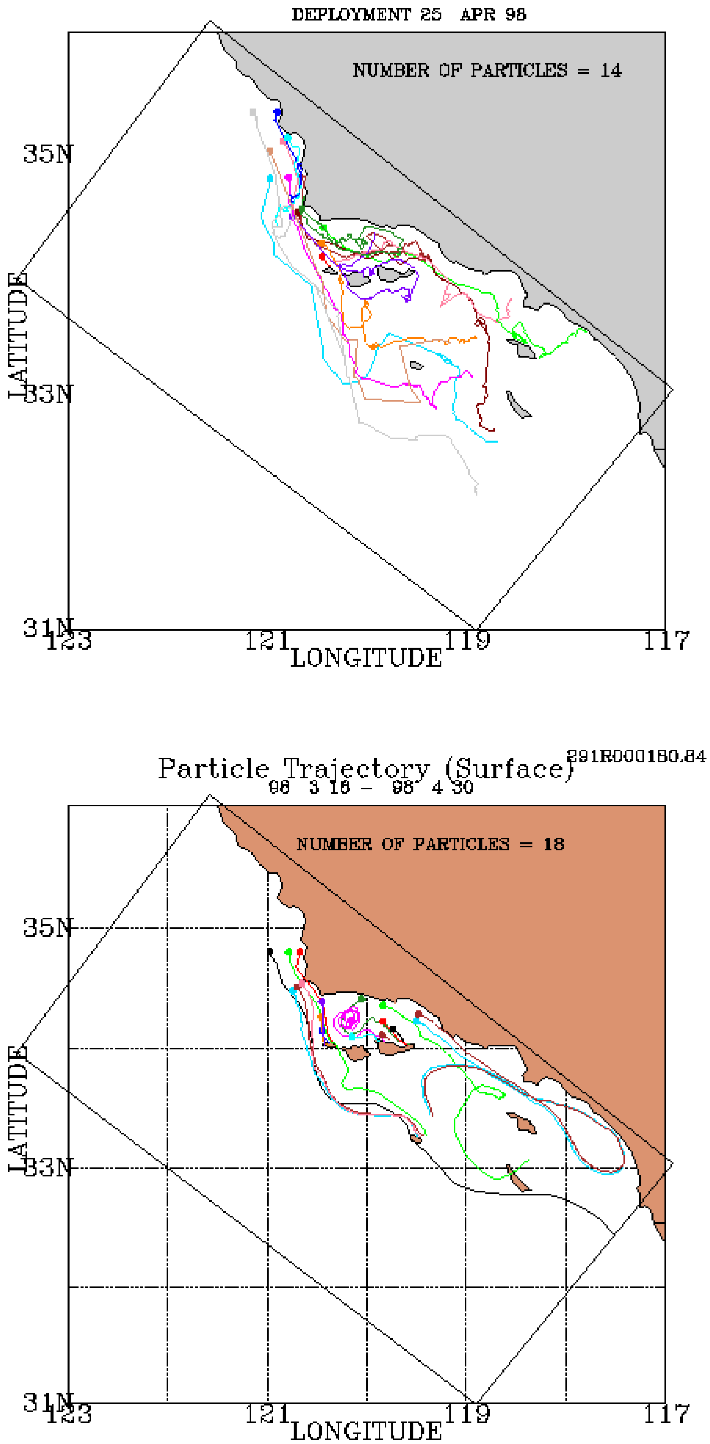
Figure 2A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